Try-Mopsa
Relational Static Analysis in Your Pocket

Raphaël Monat

rmonat.fr

Dagstuhl #25241

October 2025

Modular **O**pen **P**latform for **S**tatic **A**nalysis [Jou+19]

`gitlab.com/mopsa/mopsa-analyzer` or `opam install mopsa`

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  - Supports large subsets of C, Python
  - Academically competitive on real-world benchmarks (SV-Comp)

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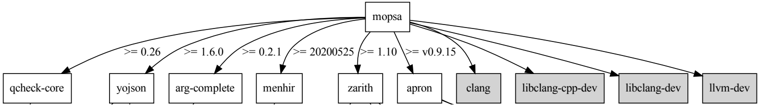

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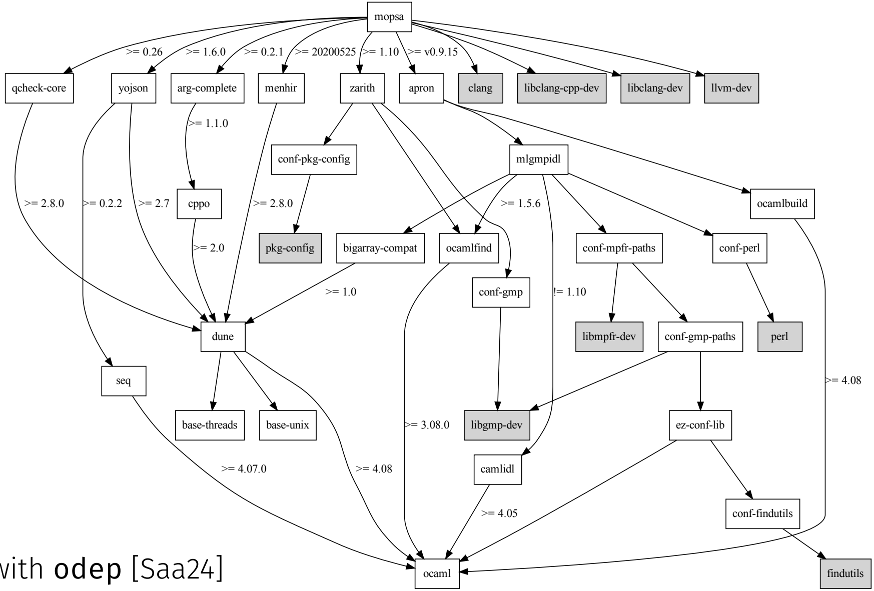

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- Features responsive interface supporting smartphones to computers
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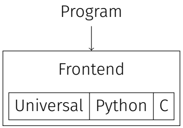
- Can be convenient for onboarding or teaching?

Outline

Under the Hood of Try-Mopsa

Overview of Mopsa



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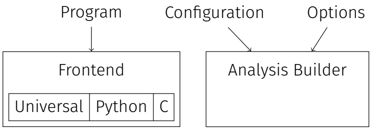

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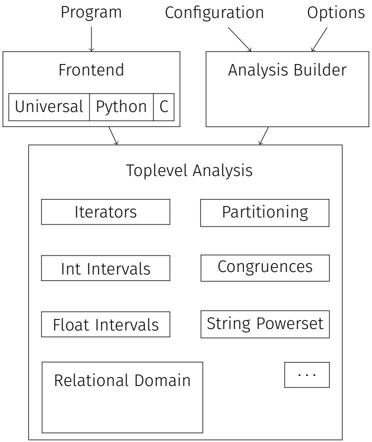

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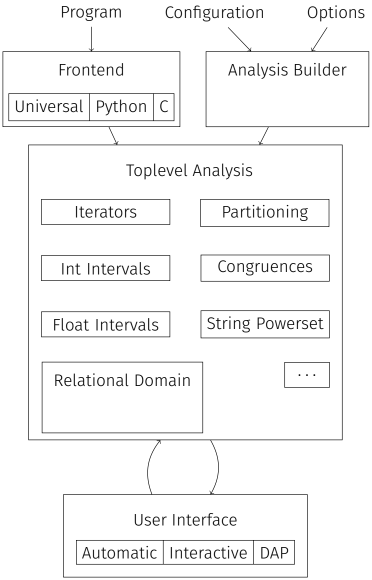

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Rely on Js_of_ocaml [VB14]

89% of Mopsa's codebase is written in OCaml

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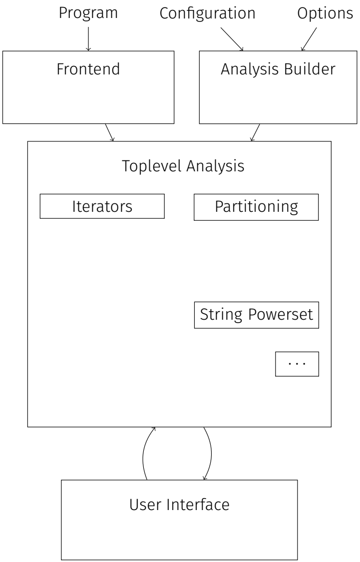

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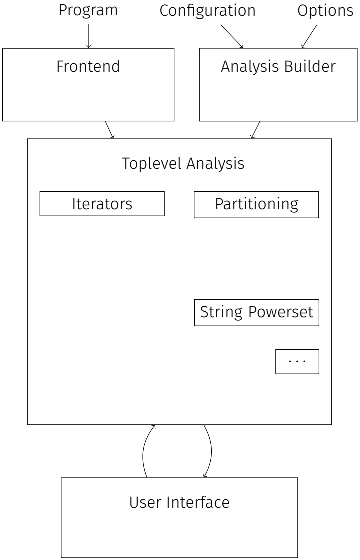

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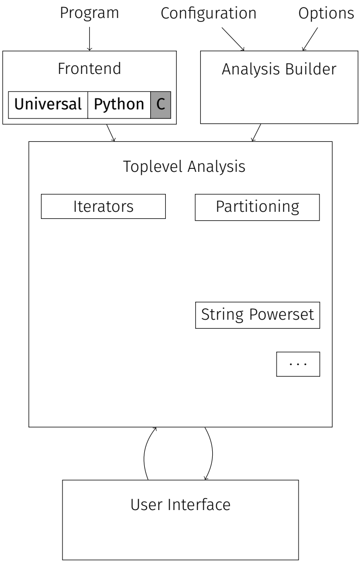

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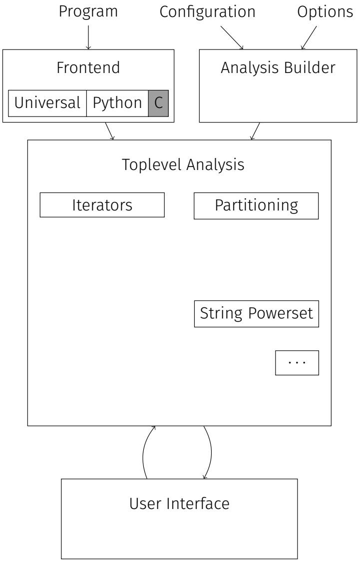

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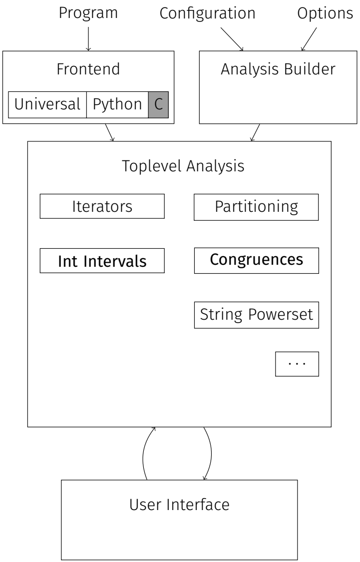

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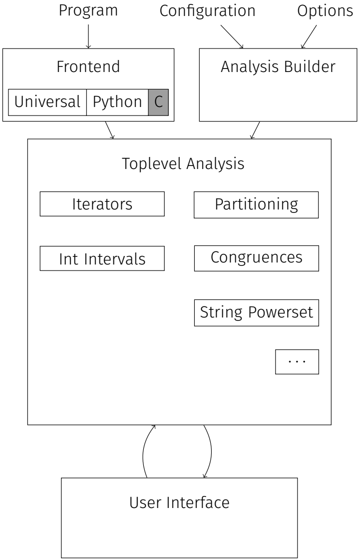

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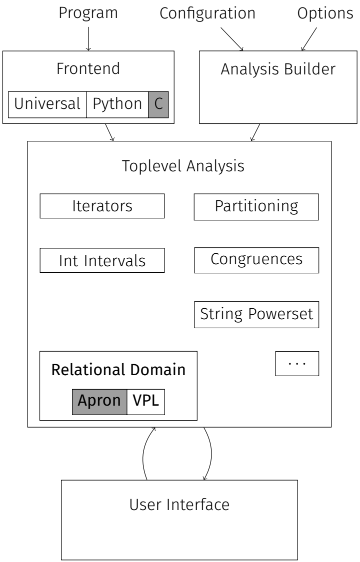

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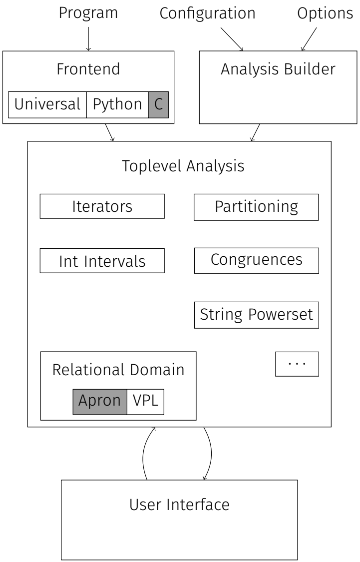

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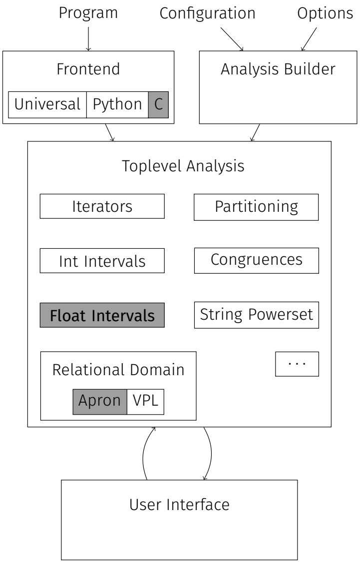

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$\Longrightarrow$ Rely on `sync-message` [Moj23] (low-level synchronous comm.)

Interface Overview

Demo!

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int i = 1;
while('a' + i <= 'z') {
  if (rand(0, 1)) break;
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Implementation Discussion

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  - *No breaking changes*

Program	Binary execution	Firefox execution
attributes.py		
fspath		2
list.py		3
loop.p		3
recen		3
str_alphabet.u	0.04s ± 0.01	0.20s ± 0.01
str_alphabet2.u	0.23s ± 0.01	0.81s ± 0.01
str_conc_loop.u	0.08s ± 0.01	0.29s ± 0.01
str_conc_loop2.u	0.04s ± 0.01	0.15s ± 0.01

- 5× slowdown compared to native binary
- Raw performance is not a priority
- Still reasonable analysis times

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Playwright framework to asses the browser compatibility of Try-Mopsa

Conformance tests

5 tests x (3 desktop browsers + 2 mobiles browsers x 2 viewports)

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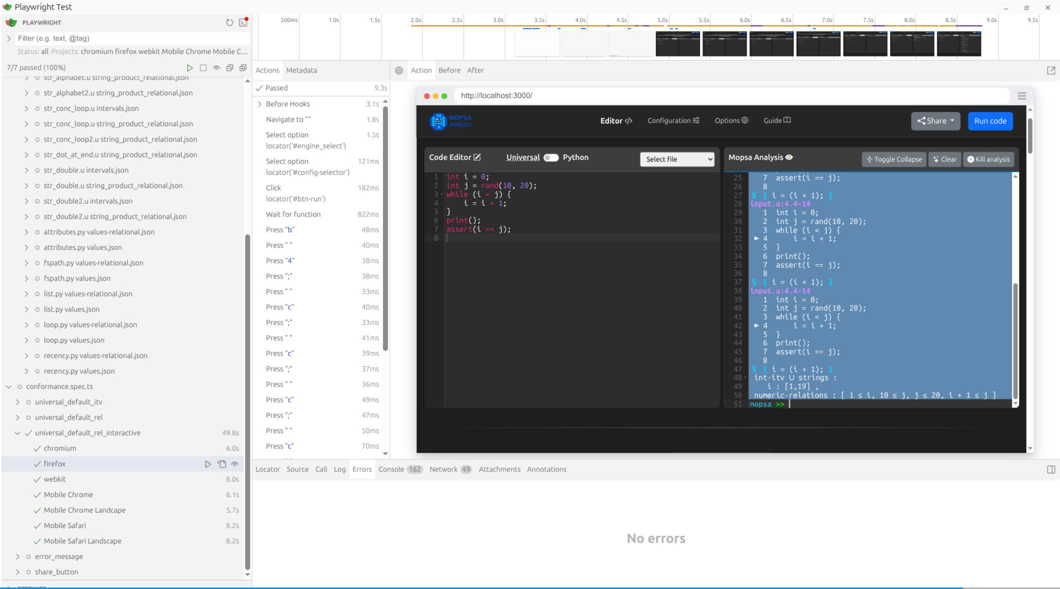
Additional tests

Universal: 13 programs x 11 configurations

Python: 5 programs x 6 configurations

Browser compatibility (II)



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Related Work

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- Works between concrete and abstract debuggers [Do+20; Hol+24; MVR23]

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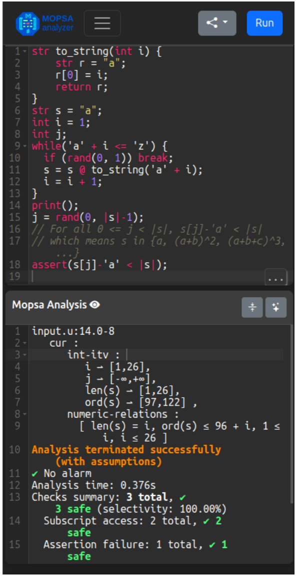

- Pure JS version of Mopsa

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MOPSA analyzer

Run

```
str to_string(int i) {
    str r = "a";
    r[0] = i;
    return r;
}
str s = "a";
int i = 1;
int j;
while('a' + i <= 'z') {
  if (rand(0, 1)) break;
  s = s @ to_string('a' + i);
  i = i + 1;
}
print();
j = rand(0, |s|-1);
// For all 0 <= j < |s|, s[j]-'a' < |s|
// which means s in {a, (a+b)^2, (a+b+c)^3, ...}
assert(s[j]-'a' < |s|);
```

Mopsa Analysis

```
input.u:14.0-8
  cur :
    int-itv :
      i ↦ [1,26],
      j ↦ [-∞,+∞],
      len(s) ↦ [1,26],
      ord(s) ↦ [97,122] ,
    numeric-relations :
      [ len(s) = i, ord(s) ≤ 96 + i, 1 ≤ i, i ≤ 26 ]
Analysis terminated successfully (with assumptions)
✔ No alarm
Analysis time: 0.376s
Checks summary: 3 total, ✔ 3 safe (selectivity: 100.00%)
  Subscript access: 2 total, ✔ 2 safe
  Assertion failure: 1 total, ✔ 1 safe
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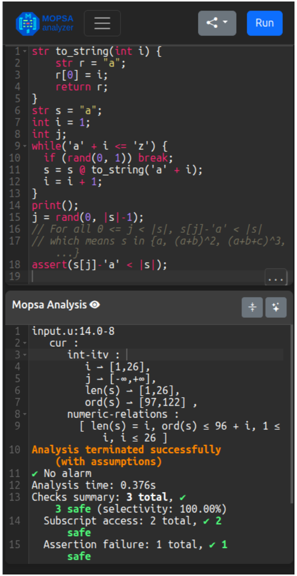

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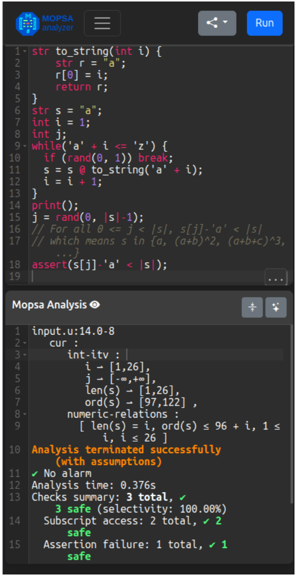

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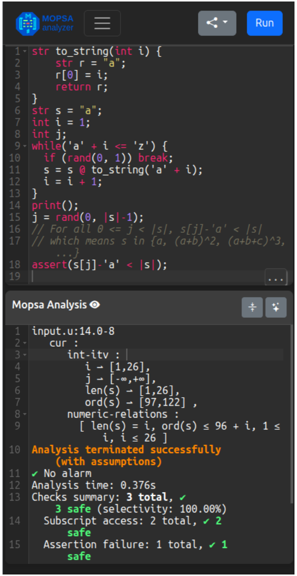

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